REMARKS

Reconsideration of this application is respectfully requested. Examiner Olsen is thanked for a courteous interview with the undersigned earlier today. A summary of the comments advanced to Examiner Olsen during that interview are included in the following remarks.

The Examiner is thanked for correcting the numbering of claims added by the April 16, 2002 amendment -- including the numbered claim dependencies (in view of the new claim numbering). Accordingly, all amendments presented herein are presented as a first amendment to the claims now already corrected in numbering. The spelling noted by the Examiner at claim 18, line 3 has also been corrected.

The rejection of claims 17 and 20 under 35 U.S.C. §112 (second paragraph) is respectfully traversed. These claims have been amended above so as to explicitly require the gas concentration sensor to have an expected minimum level of output current during normal sensing operation. Accordingly, subsequent recitation in the claim requiring a connecting conductor to have a length selected as a function of the expected minimum level of output current has proper antecedent basis and is not possibly "confusing" in the manner suggested by the Examiner.

The rejection of claims 15, 17, 18 and 20 under 35 U.S.C. §103 as allegedly being made "obvious" based on EP '591 in view of EP '423 and one of Taylor '808, Bryan et al '456 or Kida '624 is respectfully traversed.

As explained in the "background of the invention" section of the applicant's specification (e.g., see page 2, lines 4-14), the applicant's claimed invention is directed toward the installation/use of a special type of gas sensor which, in normal operation, is expected to have a minimum current output of as little as 5 to 10 μA) -- or even less, see Figure 6.

Furthermore, the applicant's claimed invention is directed towards the installation/use of this type of sensor in a specific environment, namely, an automotive electrical system wherein there are numerous sources of electrical noise that may be inductively coupled to long lead wires extending from a sensor to a central processor. In such situations, depending upon the vehicle and the installation geometry, such a small current output from the sensor may be substantially contaminated by electrical noise if it is conducted on a relatively long conductor to a central processor (i.e., induced electrical noise is a function of the length of conductor linked to noise-sources of magnetic flux).

In particular, sensors having such weak current outputs, located in such a noisy environment, have been adapted thereto by the applicant's invention where the length of signal conductor conveying such very weak current signals is determined as a function of the expected minimum level signal output from the sensor. That is, the weaker the

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expected minimum signal current, the shorter the length of the conductor before serious noise contamination may occur. As explained at page 3, lines 8-10, the applicant's preferred mode of invention utilizes a suitably short length of conductor between the sensor and a connector -- and disposes a microprocessor signal processing circuit in the connector itself such that thereafter signals conducted to a central processor are relatively higher level digital data signals substantially immune from the electrical noise environment (as compared to the weaker current signals output from the gas sensor itself). Accordingly, the relatively short conductor length between the connector (having the built in microprocessor designed to service the sensor) and the sensor facilitates location of the sensor sub-assembly (with its microprocessor housed in its own connector) at virtually any desired location in the vehicle. That is, the length of conductor used between the connector and the central processor within the automotive environment is no longer a critical design parameter.

The Examiner is specifically referred to page 13, lines 4-23 where the applicant specifically explains three major advantages accruing from the applicant's provision of a sensor control circuit 510 and heater control circuit 520 built into the connector 300 which, through other signal conductors, eventually is connected to the central processor ECU 20. As the applicant has noted, in a typical prior art structure, the sensor control circuit 510 and the heater control circuit 520 are disposed in the central ECU 20. However, the applicant's exemplary embodiment integrates those critical processing,

analyzing and control components near the gas concentration sensor 100. As a result, there are significant advantages, at least three of which are specifically noted and described in detail at page 13.

The Examiner is also referred specifically to the explanation beginning at page 21, line 26 and continuing to page 23, line 14 where many advantages of the applicant's invention are also specifically described. Page 25, lines 16 through page 26, line 3 is also worthy of careful review. With respect, none of the five references cited by the Examiner has a localized sensor signal processing, analyzing and control microprocessor housed in a sensor connector -- capable of being connected to arbitrary length signal conductors thereafter for conveying digital data signals to a centralized processor.

The Examiner admits that EP '591 does not disclose the use of a signal processing circuit within a connector but relies, instead, upon EP '423 which provides a "satellite module" 104 in a connector 105. The Examiner labels circuit 104 a "signal processing unit" which allows gas sensor characteristics "to be compensated (i.e., calibrated) for individual sensors". The Examiner apparently relies upon the abstract of EP '423 in making these comments.

First of all, the sensor involved in EP '423 is an oxygen concentration sensor and not the type of sensor having extremely small current output as defined in applicant's claims. Furthermore, the only reason the satellite module 104 is individually associated with a sensor connector is so as to adjust for expected dispersion in the characteristics of

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such oxygen sensors. There does not appear to be any problem whatsoever with electrical noise signals possibly masking extremely low current signals being output from the sensors. Nor is there any apparent impedance control associated with the locally situated analog module 104.

The Examiner alleges that it would have been "obvious" to modify EP '591 with the teachings of EP '423 so that the EP '591 sensor would be compensated for variations in sensor performances (i.e., dispersion in sensor characteristics). However, it appears that the primary thrust of the EP '591 reference is, for a quite different kind of sensor, an alternate measurement algorithm that itself already does suppress variation in detector outputs (at least with respect to temperature) -- while realizing a high signal-to-noise ratio. See, for example, column 3, lines 28-34 and column 6, lines 17-37 and column 7, lines 2-7. Accordingly, those having only ordinary skill in the art would have no motivation to make the combination suggested now, in hindsight, by the Examiner.

The Examiner further admits that neither the primary nor secondary references teach use of a microcomputer for the claimed localized signal processing circuit (indeed, the primary reference EP '591 does not even suggest localized signal processing circuits of any kind). To supply this admitted further deficiency, the Examiner alleges that it would be "obvious" to use microprocessors in place of conventional analog circuits because such is "well known in the art". Of course, as the Examiner no doubt already appreciates, none of the three tertiary references is directed to the type of sensor claimed

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by the applicant -- and, like the primary and secondary references, none of the three tertiary references is directed to the problem being addressed by the applicant's invention (let alone any solution to such non discussed problem).

With respect to the "length of the conductors" feature (earlier addressed pursuant to 35 U.S.C. §112(2)), the Examiner also admits that none of the cited references have any teaching whatsoever with respect to relative lengths of conductors used for connecting the gas sensor to sensor circuits. Nevertheless, the Examiner alleges that selecting a suitable length conductor appropriate for a particular current level would be "inherent" in the '423 reference. However, it is respectfully noted that since none of the references (including EP '423) even so much as address the induced noise problem encountered with the claimed type of sensor, there is no reason to suppose that cable 103 in EP '423 has a length that is in any way limited by the relatively higher expected minimum current levels being produced by the quite different (oxygen) sensor described in the '423 reference.

To the extent that the Examiner associates line losses (i.e., resistive voltage drops) with line lengths and posits an alternate theory of "obviousness" based on that as a reason for using relatively shorter length cables in the prior art, it is respectfully traversed. The applicant is addressing induced electrical noise issues -- not loss of signal due to voltage drops (i.e., resistive dissipation) that might occur over longer length conductors. After

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all, this problem could be addressed by simply using a larger diameter conductor or one that is made of higher conductivity material.

As discussed in previous remarks, one essential feature of the invention is installation of a sensor controller or microcomputer <u>in a connector</u> for electrical connection with a remote signal processor. This <u>minimizes electric noise</u> signals that are undesirably added to an extremely weak sensor output signal -- and also permits the distance between the connector and the sensor to be maintained, if desired, at a constant distance, regardless of the distance between the sensor and an engine ECU (which usually differs among different types of vehicles). Thus a length of a conductor connecting the sensor and the microcomputer can be fixed, if desired, to <u>also</u> maintain <u>the resistance value of this initial signal link to be constant even when installed in different types of vehicles</u>, thereby improving controllability of the heater (103), to reduce delay in activating the sensor and overheating thereof (see pages 22 to 24, especially page 23 of the original application text).

The rejection of claims 15, 17, 18 and 20 under 35 U.S.C. §103 as allegedly being made "obvious" based on EP '591 in view of Amtmann et al '277 is also respectfully traversed.

Some of the deficiencies of the primary EP '591 reference have already been noted above. As the Examiner has already noted, applicant enjoys a USPTO filing date of December 3, 1999 and has claimed priority rights back to December 4, 1998. A certified

English translation of applicant's priority document will be submitted in due course to demonstrate that Amtmann '277 does not qualify as "prior art" (e.g., is based on a PCT application filed August 10, 1999 -- and even if this earliest possible date is asserted to be an effective date under 35 U.S.C. §102(e), it is easily annotated by applicant's priority date. In any event, for reasons already noted the primary EP '591 reference is believed to be deficient even if Amtmann '277 is considered to constitute prior art.

The rejection of claims 16 and 19 under 35 U.S.C. §103 as allegedly being made "obvious" based on EP '591, EP '423 and any one of Kida, Bryan (or EP '591 in view of Amtmann) -- and <u>further</u> in view of Takami et al '418 is also respectfully traversed.

This complicated three or four way modification is, on its face, clearly <u>not</u> "obvious" without undue hindsight.

Furthermore, Takami is directed to a gas sensor of a completely different type than that being addressed and claimed in the applicant's invention -- and does not, in any event, address the electrical noise problem addressed by the applicant for the particular type of gas sensor being claimed. If anything, Takami appears to teach long distance communication back to a central microprocessor 20 rather than a locally situated microprocessor as required by applicant's claims.

It is respectfully submitted that without use of undue hindsight, straightforward "combination" of these references would not be "obvious" to those having only ordinary

skill in the art in 1998. Certainly it would not have been "obvious" to selectively take a piece of each of three or four or perhaps even more references and recombine them as now suggested by the Examiner.

In discussing applicant's earlier arguments, the Examiner alleges that a patent cannot be granted for an applicant's discovery of a result that would flow logically from the teaching of the prior art. However, for reasons noted above, it is respectfully submitted that the Examiner has used considerable hindsight reasoning to <u>read into</u> one or more of the cited references features that are simply not taught by those references. For example, none of the references teach a solution for the electrical noise problem to be encountered with the claimed type of sensor in an automotive environment.

During the interview the above changes to claims 15 and 18 were discussed as distinguishing from the cited references. Accordingly, this entire application is now believed to be in allowable condition and a formal Notice to that effect is respectfully solicited.

Attached hereto is a marked-up version of the changes made to the claim(s) by the current amendment. The attached page(s) is captioned "<u>**Version With Markings To Show Changes Made**</u>."

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Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please substitute the following amended claim(s) for corresponding claim(s) previously presented. A copy of the amended claim(s) showing current revisions is attached.

Amend claims 15, 17, 18 and 20 to obviate possible formality issues:

15. (Amended) A gas concentration measuring apparatus comprising:

a gas concentration sensor having a sensor element and an electrical connector for connection to a remote digital signal processor,

said sensor element including a pump cell and a sensor cell, the pump cell being made of a solid electrolyte body and a first and a second pump cell electrode, the first and second pump cell electrodes being responsive to application of voltage to disassociate and pump oxygen molecules contained in exhaust gases of an automotive engine to which said gas concentration sensor is exposed out of said gas concentration sensor, said sensor cell being made of a solid electrolyte body and a first and a second sensor cell electrode, the first and second sensor cell electrodes being responsive to application of voltage to disassociate at least one of NO_x HC, and CO contained in the exhaust gases through the first sensor cell electrode to produce a current signal flowing through the solid electrolyte body as a function of concentration of the at least one of NO_x, HC, and CO; and

a microcomputer disposed within said connector [including a] performing functions of a gas concentration determining [circuit], [an] impedance measuring [circuit], and [a] heater control [circuit], the gas concentration determining [circuit] being functionally connected to the first and second sensor cell electrodes [and processing] to process and analyze the current signal provided by said gas concentration sensor to output [a voltage signal] data as a function of the concentration of the at least one of HO_x, HC, and CO to said remote digital signal processor through serial digital signal communication, the impedance measuring [circuit] function measuring an impedance of the sensor element of said gas concentration sensor, the heater control [circuit] function controlling [a] power supply to a heater which heats the sensor element based on the measured impedance.

17. (Amended) A gas concentration measuring apparatus as in claim 15 wherein said gas concentration sensor has an expected minimum level of output current during normal sensing operation and further comprising:

a conductor electrically connecting said gas concentration sensor and said microcomputer for transmission of the current signal from said gas concentration sensor to said microcomputer,

said conductor having a length selected as a function of [a] said expected minimum level of the current signal outputted from said gas concentration sensor.

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18. (Amended) A method for operating a gas concentration sensor having a sensor element and an electrical connector for connection to a remote digital signal processor, said sensor element including a pump cell and a [ensor] <u>sensor</u> cell, the pump cell being made of a solid electrolyte body and a first and a second pump cell electrode, the first and second pump cell electrodes being responsive to application of voltage to disassociate and pump oxygen molecules contained in exhaust gases of an automotive engine to which said gas concentration sensor is exposed out of said gas concentration sensor, said sensor cell being made of a solid electrolyte body and a first and a second sensor cell electrode, the first and second sensor cell electrodes being responsive to application of voltage to disassociate at least one of NO_x, HC, and CO contained in the exhaust gases through the first sensor cell electrode to produce a current signal flowing through the solid electrolyte body as a function of concentration of the at least one of NO_x, HC, and CO, said method comprising:

providing in said connector a microcomputer [including a] <u>performing functions of</u> gas concentration determining [circuit], [an] impedance measuring [circuit], and [a] heater control [circuit], the gas concentration determining [circuit] being <u>functionally</u> connected to the first and second sensor cell electrodes [and processing] <u>to process and analyze</u> the current signal provided by said gas concentration sensor to output [a voltage signal] <u>data</u> as a function of the concentration of the at least one of HO_x, HC, and CO to said remote digital signal processor through serial digital signal communication, the impedance measuring [circuit] <u>function</u> measuring an impedance of the sensor element of

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said gas concentration sensor, the heater control [circuit] function controlling a power supply to a heater which heats the sensor element based on the measured impedance.

20. (Amended) A method as in claim 18 wherein said gas concentration sensor has an expected minimum level of output current during normal sensing operation and wherein a gas concentration measuring apparatus as a conductor electrically connects said gas concentration sensor and said microcomputer for transmission of the current signal from said gas concentration sensor to said microcomputer,

said conductor having a length selected as a function of [a] said expected minimum level of the current signal outputted from said gas concentration sensor.